Remarks

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Thus, without reducing the scope of the claims, they have been amended to overcome the rejection of claims 11-31 under the second paragraph of 35 U.S.C. §112, rendering this rejection moot. As a result of these amendments, new claims 32-43 have been added to the application. These new claims are directed to the preferred embodiments which have been deleted from the amended claims in response to the rejection under 35 U.S.C. §112.

The patentability of the presently claimed invention over the disclosures of the references relied upon by the Examiner in rejecting the claims will be apparent upon consideration of the following remarks.

Thus, the rejection of claims 21-31 under 35 U.S.C. §102(b) or 35 U.S.C. §103(a) based on WO 97/40076 is respectfully traversed.

WO 97/40076 is cited and discussed in the present application (first full paragraph on page 4, and the paragraph bridging pages 4 and 5) by reference to the corresponding Norwegian patent NO 961625.

WO 97/40076 relates to a procedure for producing PVC particles with a narrow size distribution in the range 10-50 microns, where in a first stage a vinyl monomer or a mixture of monomers is polymerized to form a polymer/oligomer seed particle, and in a second stage another vinyl monomer or mixture of monomers is swelled into the polymer/oligomer seed particles, and polymerization takes place in such a way that they grow into polymer particles of the desired size (claim 1). Claim 10 of the reference discloses that in order to avoid phase separation problems, the second stage is carried out with continuous dosing of monomer.

The novel feature of the process of the present invention is that it allows production of spherical polymer particles by adding and swelling all of the monomer directly into start (seed) particles of a non-crosslinked polymer produced by dispersion polymerization and which have a swelling capacity of 5 times, preferably more than 20 times their own volume (claim 11).

WO 97/40076 is limited to production of PVC particles, which means that vinyl chloride monomer is the main (and only) monomer. PVC is not soluble in its own monomer and therefore a significant phase separation will occur unless the monomer is continuously dosed to the growing particles. This fact is illustrated through Figures 1 to 3 in WO 97/40076, Figures 1 and 2 illustrating phase separation yielding irregular shaped particles and Figure 3 illustrating spherical particles obtained as a result of continuous and controlled growth of the particles by continuously dosing the monomer.

The obvious result of this is that spherical PVC particles are not obtained using the present invention, and that the present invention is new in that it has the new feature of obtaining spherical polymer particles through the direct and one step swelling of a highly swellable, non-crosslinked polymer produced by dispersion polymerization before subsequently carrying out the polymerization.

For these reasons, Applicants take the position that the subject matter of claims 21-31 is patentable over WO 97/40076.

The rejection of claims 11-21 under 35 U.S.C. §102(b) as being anticipated by Kasai et al. is respectfully traversed.

Kasai et al. describes a swelling process for the production of monodisperse particles in the size range of 0.1 to 500 μm. To achieve the desired result the monomer is dispersed as finely divided droplets in a so-called semistable or metastable condition. The diameter of the monomer droplet, D_m, needs to satisfy the expression: $0.5D<D_m,<3.5D$ (equation (a)), where D is the desired particle diameter.

It is well known that monodisperse particles can easily be made by seeded polymerization as long as the start particles are monodisperse and the thermodynamic condition for swelling is satisfied. This is described by the Morton equation and thoroughly discussed in the present application (page 2, starting from line 20).

The equilibrium swelling of monomer when monomer is finely divided in droplets can be calculated from the following expression (extended Morton equation):

$$\ln(\varphi)_m + (1-1/J_p)\varphi_p + \varphi_p^2\chi + 2V_m\gamma_p/r_pRT = 2V_m\gamma_m/r_m RT$$

where φ_m and φ_p are the volume fractions of the monomer and polymer, respectively, J_p is the polymer's chain length, χ is the interaction constant between monomer and polymer, V_m is the monomer's partial molar volume, r_p and r_m are the radius of the desired particle and the monomer droplets, respectively, γ_p and γ_m are the interfacial tension of the particles and the monomer droplets, respectively, R is the ideal gas constant and T is the temperature.

The absorption of monomer or swelling capacity of the seed particles can be increased by:

1. decreasing the polymer chain length (decreases J_p)
2. adding a low molecular compound with very low water solubility (decreases J_p)
3. decreasing the interaction constant between monomer(s)/solvent(s) and polymer (decreases χ)
4. decreasing the interfacial tension of the particles (decreases γ_p)
5. increasing the diameter of the particles (increases r_p)
6. decreasing the diameter of the monomer droplets (decreasing r_m)
7. increasing the interfacial tension of the monomer droplets (increasing γ_m)

It is well known that when the seed particles consist of any general polymer ($J_p = \infty$) the swelling capacity is very limited and will never exceed a ratio of 5 regardless of all other parameters that can be varied. This is documented in the well-known Ugelstad patents (NO 142082 and NO 143403) referred to in the present application (page 4, lines 10-25). The Kasai et al. reference discloses that making a semistable monomer emulsion (high γ_m) with a diameter of the droplets in the monomer emulsion in a special range dependent upon the desired particle size (variation of r_p and r_m) is advantageous. It is also described that as long as the relation as represented by equation (a) is satisfied, the seed particles can easily be swollen, usually to about 1,000 to 10,000 times the original size (column 8, lines 15-20). This will only be true if the seed particles consist of a "low" molecular compound with low water solubility or an oligomer, and not a general polymer (J_p not ∞), referring to the extended Morton equation, Ugelstad's patents and general knowledge of those skilled in the art. In Kasai et al. the high swelling capacity is achieved by adding to the monomer an oily substance that has a water solubility of not more than 1/100 of the polymerizable monomer (claim 4). They

claim that this effects the size distribution of the monomer droplets, probably underestimating the effect of this compound acting as a swelling agent of the particles.

In the present invention, there are no limitations with regard to monomer droplet size or stability of emulsion that need to be fulfilled to achieve high swelling capacity. The seed particles in themselves have the ability to absorb or being swollen in huge amounts only by adding monomer and/or solvents to the seed particles. The reason for this is that the seed particles are a non-cross-linked polymer produced by a dispersion polymerization. This is completely different from what is disclosed in Kasai et al.

For these reasons, Applicants take the position that the subject matter of claims 11-21 is patentable over the Kasai et al. reference.

The rejection of claims 11-21 under 35 U.S.C. §103(a) as being unpatentable over WO 98/31714 is respectfully traversed.

WO 98/31714 describes a procedure for producing self activated polymer particles with a narrow size distribution in the range 0.5-15 μm by dispersion polymerization. This is done by gradually increasing the temperature set point over a certain interval of time so that molecules with a lower molecular weight are formed; and in addition to that conversion speed is increased (claim 1).

The present invention provides a process for producing spherical polymer particles with a diameter in the range between 5 and 100 pm and a narrow size distribution in a one step seed polymerization. This is achieved by using start particles of a non-crosslinked polymer produced by dispersion polymerization and having a swelling capacity above 5 times, preferably above 20 times their own volume. This means that the start particles might be produced by the procedure described in WO 98/31714 or by any other dispersion polymerization method.

Thus, the present invention relates to the production of spherical polymer particles by seed-polymerization, while WO 98/31714 relates to a special way of producing such <u>seed</u> particles.

For these reasons, Applicants take the position that the subject matter of claims 11-21 is patentable over WO 98/31714.

In conclusion, <u>the present invention solves the problem of making spherical particles from start (seed) particles with a high swelling capacity and a narrow size distribution in a one step seed</u>

polymerization without any other measures than making the seed by dispersion polymerization. This is completely different from what is taught by WO 97/40076, Kasai et al. and WO 98/31714. The surprising results obtained when preparing spherical polymer particles have, to Applicants' knowledge, not been disclosed in any prior art.

Therefore, in view of the foregoing amendments and remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

Respectfully submitted,

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